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7 Abstract

This report is provided to support an engineering study being prepared on alternative methods to sample Tank 241-CX-71 located at the Strontium Semiworks complex at 200-E Area. An investigation of available historical documentation was conducted to provide information on the waste characterization of this tank.

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TANK 241-CX-71 PRELIMINARY WASTE CHARACTERIZATION

June 30, 1989

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TANK 241-CX-71 PRELIMINARY WASTE CHARACTERIZATION

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TANK 241-CX-71 PRELIMINARY WASTE CHARACTERIZATION

EXECUTIVE SUMMARY

This report is provided to support an engineering study being prepared on alternative methods to sample the 241-CX-71 tank located at the Strontium Semiworks complex. An investigation of the available historical documentation on this tank was conducted to provide some information on the possible radiological and chemical constituents in this tank. This investigation included review of available documents, search of laboratory records for evidence of previous sampling analyses, and discussions with present as well as retired employees who are familiar with the history of this tank. No drawings exist to substantiate the dimensions of this tank but documentation indicates it to be a cylindrical, single-shell, stainless steel tank approximately 9 ft in diameter and 9 ft deep. A sketch of the configuration of Tank 241-CX-71 is attached. The time sequence of historical events at Strontium Semiworks is also attached.

The Strontium Semiworks records were sent to the Record Center after the Redox and Purex processes. Most of these records were destroyed in 1982. No microfiche of these records exist. Some early documentation does exist at the Battelle Library, some of which is classified and therefore access is limited. An extensive review of the historical documents that were available has revealed a number of inconsistencies. This is due in part to the nature of record keeping and data collection methods used during the 1950s and 1960s.

Based on available historical documentation, Tank 241-CX-71 was used during the Reduction Oxidation (REDOX) operations, the Plutonium Uranium Extraction (PUREX) operations, and the decontamination flushes following the completion of the PUREX operations. The tank was used to neutralize waste from the 201-C Building and the Hot Shop sink before routing to Crib 216-C-1. Historical information on Crib 216-C-1 is also included in this investigative report. Crib 216-C-1 was also used during the REDOX operations, the PUREX operations, and the decontamination flushes following completion of the PUREX operations. Although no correlation of the quantities of radionuclides estimated for Crib 216-C-1 can be made for Tank 241-CX-71, it would be expected that the tank and the crib would share the same species of radionuclides.

Although the types of chemicals and chemical compositions used are documented, the quantities used and the current compositions are unknown; i.e, limestone present in the tank would have neutralized chemicals such as nitric acid.

The REDOX process used a solvent extraction process to remove plutonium and uranium from dissolved fuels into a <u>methyl isobutyl ketone (hexone)</u> solvent. Waste streams from the REDOX process were slightly acidic and contained fission products and large volumes of <u>aluminum nitrate</u> used to promote extraction of the plutonium and uranium.

EXECUTIVE SUMMARY (Cont'd)

The PUREX process was an advanced extraction process using tributyl phosphate in kerosene solvent to extract plutonium and uranium from acid solutions of irradiated uranium. Nitric acid was used to promote extraction of plutonium and uranium as opposed to the metallic nitrates used in the REDOX process. Process condensates from the PUREX process contained predominantly dilute nitric acid and other inorganic contaminants.

A list of the decontamination solutions used for the various contamination and fission product species is attached.

A formal waste designation has not been performed on the waste in this tank because the quantity and concentrations of constituents are not known. Although the composition of the decontamination flushes used is known, the quantity used for each flush is not known. The presence of chromium in the decontamination flushes would cause the tank contents to be designated as potentially DANGEROUS WASTE. Other constituents, especially fluoride, would also influence the DANGEROUS WASTE designation.

1.0 INTRODUCTION

This report is provided to support an engineering study being prepared on alternative methods to sample the 241-CX-71 tank located at the Strontium Semiworks at the 200-E area. An investigation of the available historical documentation on this tank was conducted to provide some information on the possible radiological and chemical constituents in this tank. This investigation included review of available documents, search of laboratory records for evidence of previous sampling analyses, and discussions with present as well as retired employees who are familiar with the history of this tank.

Based on available historical documentation, Tank 241-CX-71 was used during the REDOX operations, the PUREX operations, and the decontamination flushes following the PUREX operations. The tank was used for neutralizing the 201-C process condensate and the coil and condenser cooling water. After the decontamination flushes, the tank was no longer used after June 1957. The time sequence of historical events at Strontium Semiworks is shown in Attachment 1.

No drawings exist to substantiate the dimensions of this tank but documentation indicates it to be a cylindrical, single-shell, stainless steel tank approximately 9 ft in diameter and 9 ft deep. The configuration of Tank 241-CX-71 is shown in Attachment 2.

Crib 216-C-1 was closely associated with Tank 241-CX-71 and was used during the same timeframe (REDOX, PUREX, and decontamination solutions). Historical information on Crib 216-C-1 is included in this report as it would be expected that the tank and the crib would share the same species of radionuclides.

2.0 HISTORICAL DOCUMENTATION

Because of the great length of time that this tank has been in existence and the nature of historical record keeping practices and resultant conflicting information, the historical data presented is coordinated directly with the corresponding reference source. Quotation marks have been eliminated.

2.1 HISTORY OF STRONTIUM SEMIWORKS AND TIME SEQUENCE OF EVENTS

NOTE: See Attachment 1 for time sequence of historical events.

2.1.1 <u>Ref: "Level I Remedial Investigation Work Plan - 200 Area Strontium Semiworks Liquid Waste Disposal Sites", prepared by Pacific Northwest Laboratories (PNL), issued September 1987</u>.

PAGE 2-25: The REDOX process was the first process to recover both plutonium and uranium from irradiated fuel materials. The process used a solvent extraction process to remove plutonium and uranium from dissolved fuels into a methyl isobutyl ketone (hexone)

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.1 HISTORY OF STRONTIUM SEMIWORKS AND TIME SEQUENCE OF EVENTS (Cont'd)

solvent. Waste streams from the REDOX process were slightly acidic and contained fission products and large volumes of aluminum nitrate used to promote extraction of the plutonium and uranium.

PAGE 2-25: The Strontium Semiworks facility was placed in service in 1952 and was first used in demonstration of the REDuction and OXidation (REDOX) process and later for demonstration of the Plutonium and Uranium Recovery through EXtraction (PUREX) process until 1956. The facility was out of service from 1956 to 1960 and was then modified for recovery and purification of Sr-90 (Strontium 90) from other Hanford reprocessing plant by-products. The Semiworks plant was retired in 1967.

PAGE 2-25: The Strontium Recovery Process performed at the Semiworks facility utilized a complex liquid organic ion exchanger, di-2-ethyl-hexyl phosphoric acid, to extract strontium from acid solutions of waste fuels.

2.2 PURPOSE OF TANK 241-CX-71

2.2.1 Ref: Memo, Harlow/Teal, "Disposition and Isolation of Tanks 270-E-1, 270-W, 241-CX-70, 241-CX-71, and 241-CX-72," dated July 2, 1974.

PAGE 4: Tank 241-CX-71 was used for neutralizing the 201-C condensate and the coil and condenser cooling water from December 1952 through November 1956.

PAGE 4: Flush wastes during decontamination also went through Tank 241-CX-71 from December 1956 through June 1957. After this date, the tank was no longer used.

2.2.2 Ref: SD-DD-FL-001, Rev 0.0, "Rockwell Retired Contaminated Facility Listing and Description," by A. A. Crusselle and T. Romano, dated July 1982.

PAGE 67: 241-CX-71 tank was used to neutralize waste from 201-C and the hot shop sink before routing to 216-C-1 crib. This tank is not currently in use and is considered retired.

2.2.3 Ref: SD-WM-SAR-003 issued, dated March 1984.

PAGE 5-49: Tank 241-CX-71 was used to neutralize waste from the Building 201-C and the Hot Shop sink before routing to the 216-C-1 crib.

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.3 DESCRIPTION OF TANK 241-CX-71 AND QUANTITY OF CONTENTS

See Attachment 2, Tank 241-CX-71 Configuration.

Location: 200 East Area - N42200/W50300

Reference Drawings: H-2-4420

2.3.1 Ref: SD-DD-FL-001, Rev 0.0, "Rockwell Retired Contaminated Facility Listing and Description," by A. A. Crusselle and T. Romano, dated July 1982.

PAGE 67: 241-CX-71 is a stainless steel, underground, neutralization tank. It is 9 ft in diameter and 9 ft high. There is a gooseneck vent riser visible above grade.

2.3.2 Ref: Harlow/Teal, "Disposition and Isolation of Tanks 270-E-1, 270-W, 241-CX-70, 241-CX-71, and 241-CX-72", dated July 2, 1974.

PAGE 4: Tank 241-CX-71 contains a limestone bed similar to that in 270-E-1 and 270-W. Although an extensive search was made, no prints of the tank could be found. Personnel associated with the facility in the early 1950s recall the tank is a five foot diameter by six foot deep tank located underground about 10 feet south of the road directly behind the 201-C Building.

2.3.3 Ref: SD-WM-SAR-003 issued, dated March 1984.

PAGE 5-49: Tank 241-CX-71 is a stainless steel, underground neutralization tank. It is 9 ft in diameter and 9 ft high. A schematic of the tank is shown in Figure 5.38, which represents the best information available on this vessel. Two risers extend above grade.

PAGE 5-49: Crushed limestone was added to the vessel through the large central riser. The limestone bed reacted with any acidic material poured through the tank. As the limestone was dissolved by the acid, new limestone was periodically added to renew the bed.

PAGE 5-56: Tank 241-CX-71 contains 2,300 gal of solids (primarily limestone used for waste neutralization) and 1,500 gal of water.

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.3 DESCRIPTION OF TANK 241-CX-71 AND QUANTITY OF CONTENTS (Cont'd)

2.3.4 Ref: Memo, Mirabella/Dukelow, "Aux Tanks, Sumps, and Vaults Solids and Liquid Volumes," dated March 3, 1978.

Identification: CX-71
Capacity (Gal): 5,000
Liquid (Gal): 1,500
Solid (Gal): 2,300
Comments: Solids = Limestone

2.3.5 Ref: Aux. Tanks - Approx. Stabil. Dates, dated August 1978.

Capacity (K gal): 5.0
Liquid (K gal): 1.50
Solids (K gal): 2.30
Total (K gal): 3.80
Requires Sampling: No
Active/Inactive: Inactive
Comments: Contains limestone. Leave as is.

2.3.6 Ref: Aux. Tanks - Approx. Stabil. Dates, dated August 25, 1978.

Capacity (K gal): 5.0
Liquid (K gal): 1.50
Solids (K gal): 2.30
Total (K gal): 3.80
Liquids Level (inches): 74.5
Solids Level (inches): 52.0
Requires Sampling: No
Active/Inactive: Inactive
Comments: Contains limestone. Leave as is.
Status: ---
Approx. Stab. Date: Primary Stab.

2.3.7 Ref: Aux. Tanks - Stabil. Plan, dated January 11, 1979.

Capacity (K gal): 5.0
Liquid (K gal): 1.50
Drainable Liquid (K gal): 1.8
Solids (K gal): 2.30
Total (K gal): 3.80
Liquids Level (inches): 74.5
Solids Level (inches): 52.0
Sampling: EF
Active/Inactive: Inactive
Comments: Contains limestone. Leave as is.
Approx. Stab. Date: Interim Stab.
Stabilization Plan: INTERIM STABILIZED

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.4 HISTORICAL TANK RADIONUCLIDE DOCUMENTATION

2.4.1 Ref: Memo, Harlow/Teal, "Disposition and Isolation of Tanks 270-E-1, 270-W, 241-CX-70, 241-CX-71, and 241-CX-72," dated July 2, 1974.

PAGE 4: Flush wastes during decontamination also went through CX-71 from December 1956 through June 1957. After this date, the tank was no longer used. During this time, approximately 8.8 million gallons of waste flowed through the tank. This waste contained, on the average, 0.0033 g/gal of uranium, 9.3×10^{-8} g/gal plutonium, and 1.3×10^{-4} Ci/gal of beta emitting particles. The sources of solution to the tank were the 201-C Hot Process Building (condensate) and drain from the Hot Shops. These lines are blanked at the tank. Outlets include one to the 216-C-1 crib, which is blanked, and one to the 216-C-5 crib, which is open.

2.4.2 Ref: D0105ER00001, Rev 00 issued, "Preliminary Study for Decontamination and Decommissioning of Strontium Semiworks," by D. E. Bowers, dated November 13, 1979.

PAGE 15: Tank 71 contains trace fission product contamination, estimated at 0.03 Ci, but could be much higher as the limestone fill has not yet been analyzed.

2.4.3 Ref: SD-DD-ES-003 issued, "Strontium Semiworks Decommissioning Engineering Study," by J. M. Marzec, dated October 27, 1983.

PAGE 123: CX-71 Radiation Data*: Pu=6 Ci, Beta=6000 Ci

*Inventories are preliminary estimates made from knowledge of the operations and history of the facilities.

2.4.4 Ref: SD-WM-SAR-003 issued, dated March 1984.

PAGE 5-56: The radionuclide inventory has not been sampled, but a maximum inventory of 6 Ci of transuranic (TRU) and 6,000 Ci beta has been estimated [Radiation Monitoring Group, Radiation Work Permits, RHO-MA-172, Rev. 1, Rockwell Hanford Operations, Richland, Washington (March 1983)].

2.4.5 Ref: SD-DD-FL-001, Rev 0.0, "Rockwell Retired Contaminated Facility Listing and Description," by A. A. Crusselle and T. Romano, dated July 1982.

PAGE 67: Radionuclide Inventory: 6 curies Pu, 6,000 curies beta.

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.5 HISTORICAL TANK CHEMICAL DOCUMENTATION

NOTE: Tank CX-71 was operated during the REDOX and PUREX operations and was used during decontamination flushes.

2.5.1 Ref: "Level I Remedial Investigation Work Plan 0 200 Area Strontium Semiworks Liquid Waste Disposal Sites," prepared by PNL, issued September 1987.

PAGE 2-25: The REDOX process was the first process to recover both plutonium and uranium from irradiated fuel materials. The process used a solvent extraction process to remove plutonium and uranium from dissolved fuels into a methyl isobutyl ketone (hexone) solvent. Waste streams from the REDOX Process were slightly acidic and contained fission products and large volumes of aluminum nitrate used to promote extraction of the plutonium and uranium.

PAGE 2-25: The PUREX process is an advanced extraction process using tributyl phosphate in kerosene solvent to extract plutonium and uranium from acid solutions of irradiated uranium. Nitric acid is used to promote extraction of plutonium and uranium as opposed to the metallic nitrates used in the REDOX process. Process condensates from the PUREX Process contain predominantly dilute nitric acid and other inorganic contaminants. The volume of high level waste produced by the PUREX process is much lower per unit of fuel processed than those of previously applied processes.

2.5.2 Ref: Memo, D. G. Harlow/J. A. Teal, "Disposition and Isolation of Tanks 270-E-1, 270-W, 241-CX-70, 241-CX-71, and 241-CX-72," dated July 2, 1974.

PAGE 4: Flush wastes during decontamination also went through tank 241-CX-71 from December 1956 through June 1957. After this date, the tank was no longer used.

2.5.3 Ref: HW-52860. Undocumented, "Standby Status Report - Hot Semiworks Facility," by C. R. Cooley, dated September 1, 1957.

See Attachment 3, Decontamination Solutions.

PAGE 46: Some decontaminating reagents were determined by sending actual samples of the material to be decontaminated to the laboratory and subjecting it to a series of solutions to find which one was the most effective. Many times, the choice of the agent used was quite arbitrary since it was not known what particular species of fission product or combination of products were present. Generally, however, the principal contenders were zirconium and niobium accompanied by some ruthenium. CT (caustic-tartrate, "hot") was used quite extensively for flushing. This

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.5 TANK CHEMICAL CHARACTERIZATION (Cont'd)

was generally followed with "hot" oxalic acid. Oxalic acid was generally "killed" with hydrogen peroxide to reduce waste volume and to allow more efficient concentration (concentration of oxalic solutions is difficult) (1/7 volume of 30 percent H_2O_2 is required to kill one volume of 10 percent oxalic acid. Seventy percent is added cold and the remainder after the solution is heated to boiling).

PAGE 46: Another combination which seemed to be effective against ruthenium was PC (permanganate-caustic). This was generally followed with N-FAS (nitric ferrous ammonium sulfate) to remove the precipitated manganese dioxide. A 3-20 (fluoride nitric) flush was generally used at least once during the decontamination campaign for final cleanup. Its repeated use is not recommended because of its corrosive nature. For concrete and painted surfaces, the above flushes were generally followed with an ND (nitric dichromate) flush to remove cesium and cerium.

PAGE 46: A flow system was set up to decontaminate the tanks and the solution was transferred progressively from one tank to another. The transfers were made from low to a high contamination tank. All tanks were generally filled to near overflowing to provide solution contact with the tank top. During the course of these tank transfers, all of the auxiliary lines to each tank were flushed as well.

2.6 ASSOCIATED CRIBS - CHEMICAL/RADIOLOGICAL CHARACTERIZATION

NOTE: Historical information on Crib 216-C-1 is included in this report because waste from Tank 241-CX-71 was routed to Crib 216-C-1 and the crib and the tank were used during the same timeframe.

See Attachment 4, Description of Semiworks Cribs.

See Attachment 5, Estimated Contaminant Inventory for Semiworks Liquid Waste Disposal Sites.

2.6.1 Ref: "Level I Remedial Investigation Work Plan - 200 Area Strontium Semiworks Liquid Waste Disposal Sites," prepared by PNL, issued September 1987.

CRIB 216-C-1

PAGE 2-27: The period of time of service of the 216-C-1 crib corresponds to the periods of REDOX and PUREX process pilot scale demonstrations of the Semiworks complex.

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.6 ASSOCIATED CRIBS - CHEMICAL/RADIOLOGICAL CHARACTERIZATION (Cont'd)

PAGE 2-7: The 216-C-1 crib was constructed for disposal of chemically and radioactively contaminated waste waters from the Strontium Semiworks plant (201-C Building) in the 200 East Area. The crib was in service from January 1953 through June 1957. During this time, waste flows to the crib reportedly totaled 6.16×10^6 gallons.

CRIBS - GENERAL

PAGE 3-1: The cribs at the Semiworks were used to dispose of liquid wastes which had levels of radioactivity sufficiently low to allow ground disposal. Most of the liquid wastes disposed of to these sites were similar to the liquid wastes generated at the main Hanford production facilities (i.e., REDOX and PUREX). These wastes include process condensates and process, organic, chemical, and decontamination wastes. Process condensate consists of water condensed from closed systems that has been in direct contact with radioactive material. These wastes may be acidic or basic and contain relatively low amounts of inorganic salts, such as nitrates, some volatile organic compounds, and some volatile radionuclides, such as tritium. Process and organic wastes contain process chemicals which have been in direct contact with radioactive material. These process chemicals are used to leach, extract, or immobilize certain radionuclides and may also contain complexants that enhance the mobility of some hazardous chemicals and radionuclides. Because of the process development work that was done at the Semiworks, these wastes are expected to be more variable than the routine production wastes. Decontamination wastes consists of wastes from chemical decontamination of radioactive equipment and generally contain acids complexants, and chelating agents. The Semiworks generated relatively high amounts of decontamination wastes since the facility had only very limited capabilities for remote maintenance and service of apparatus in the hot cells. In most cases, required maintenance could only be conducted by direct contact after extensive decontamination of the affected cell.

PAGE 3-1: Estimates of the chemical and radiological inventories in each of the inactive waste disposal sites at Hanford were developed as part of the Phase I Installation Assessment (DOE, 1986a). The inventories for the sites at the Semiworks were developed based on available waste descriptions and volumes reported in historical documents, and recollections of personnel familiar with the sites. When assumptions were made, they were conservative so as to maximize the estimated waste inventory. The estimated inventories for the sites at the Semiworks are attached.

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.6 ASSOCIATED CRIBS - CHEMICAL/RADIOLOGICAL CHARACTERIZATION (Cont'd)

PAGE 3-2: It would be noted that the waste stream documentation used to develop chemical inventories for the Semiworks sites was generally representative of routine process wastes. The resultant inventories should account for the major constituents present in these wastes. Because of the nature of the process development work done at the Semiworks, however, there is the potential that these wastes contained minor constituents not normally associated with routine operations, It is likely that these waste sites received minor constituents other than those listed in Attachment 4.

PAGE 3-2: Information on the amount of the contaminant inventories which are currently remaining in the sites is extremely limited. No sampling or analysis has been performed to quantify the amount of contamination present. Radiological surface surveys indicate the presence of radioactive contamination at several crib structures and at unplanned release sites.

PAGE A-5: The Semiworks Cribs are known to contain chemical and radioactive contaminants that may include the following:

Nitric Acid
Various Metallic Nitrates
Tributyl Phosphate
Normal Paraffin Hydrocarbon (kerosene)
Methyl Isobutyl Ketone (hexone)
Strontium-90
Cobalt-60
Cesium-137
Plutonium-239,240
Uranium-238
Tritium

PAGE B-7: The following substances are known or suspected to have been disposed of at the Semiworks Liquid Waste Disposal Sites. The primary hazards of each substance are identified. The concentrations of these substances that remains in the Sites is unknown.

<u>Substance</u>: Nitric Acid (HNO3)
<u>Primary Hazard</u>: Corrosive, toxic if inhaled or ingested, oxidizer.

<u>Substance</u>: Aluminum Nitrate (Al(NO3)3)
<u>Primary Hazard</u>: Toxic if ingested, oxidizer.

2.0 HISTORICAL DOCUMENTATION (Cont'd)

2.6 ASSOCIATED CRIBS - CHEMICAL/RADIOLOGICAL CHARACTERIZATION (Cont'd)

Substance: Tributyl Phosphate (TBP)
Primary Hazard: Toxic if inhaled, ingested or absorbed through skin.

Substance: Methyl Isobutyl Ketone (MIBK)
Primary Hazard: Flammable, toxic if inhaled or ingested.

Substance: Kerosene
Primary Hazard: Flammable, toxic if inhaled or ingested.

Radionuclides: (Sr-90, Co-60, Cs-137, Pu-239,240, U-238, H-3)
Primary Hazard: Ionizing Radiation Sources.

2.7 HISTORICAL SAMPLING

2.7.1 Ref: Memo, Harlow/Teal, "Disposition and Isolation of Tanks 270-E-1, 270-W, 241-CX-70, 241-CX-71, and 241-CX-72", dated July 2, 1974.

PAGE 4: A sample of the liquid was obtained on 7/1/74. Visual inspection indicates the tank contains very little liquid.

2.7.2 Ref: One Page, Source and Author Unknown, dated 1976.

Tank: CX-71
Sample Results:
VIS-OTR: Clear, light brown, trace solids, 3.0 mR
pH: 6.80
Sr-89,90: 16.2 uCi/gal
DTA: No exotherms
Cs-137: 5.9 uCi/gal

3.0 DISCUSSION

Because of the great length of time that Tank 241-CX-71 has been in existence and the nature of historical record keeping practices and resultant conflicting information, the accuracy of some of the information obtained from the historical documentation is highly suspect. Although not necessarily true for Tank 241-CX-71, the capacities and physical descriptions of other tanks in the same document sources were highly inaccurate. In addition to the original historical inaccuracy, there was a tendency over the years to assume that a documented statement was accurate and, therefore, the same erroneous statement was repeated in subsequent documents.

3.0 DISCUSSION (Cont'd)

3.1 DISCUSSION OF HISTORICAL RADIOLOGICAL INFORMATION

Tank 241-CX-71 was used during the REDOX operations, the PUREX operations, and for the decontamination flushes following termination of the PUREX operations.

The documented inventories of 6 Ci Pu and 6,000 Ci Beta, although repeated in many documents, were given as a rough estimate and cannot be corroborated.

Although no historically reliable documentation of radionuclide inventory in the tank itself is available, there is radionuclide information on the associated Crib 216-C-1 as follows:

	216-C-1
Tritium:	70.000
Cobalt 60:	.0020
Strontium 90:	93.800
Cesium 137	.0496
Plutonium-239	.4570
Plutonium-240	.1230
Uranium 238	.0988

Although no correlation of the quantities of radionuclides estimated for Crib 216-C-1 can be made for Tank 241-CX-71, it would be expected that the tank and the crib would share the same species of radionuclides.

3.2 DISCUSSION OF HISTORICAL CHEMICAL INFORMATION

NOTE: Tank 241-CX-71 was used during the REDOX operations, the PUREX operations, and for the decontamination flushes following termination of the PUREX operations.

3.2.1 REDOX Chemicals

The REDOX process used a solvent extraction process to remove plutonium and uranium from dissolved fuels into a methyl isobutyl ketone (hexone) solvent. Waste streams from the REDOX process were slightly acidic and contained fission products and large volumes of aluminum nitrate used to promote extraction of the plutonium and uranium.

3.2.2 PUREX Chemicals

The PUREX process was an advanced extraction process using tributyl phosphate in kerosene solvent to extract plutonium and uranium from acid solutions of irradiated uranium. Nitric acid was used to promote extraction of plutonium and uranium as opposed to the

3.0 DISCUSSION (Cont'd)

3.2 DISCUSSION OF HISTORICAL CHEMICAL INFORMATION (Cont'd)

metallic nitrates used in the REDOX process. Process condensates from the PUREX process contained predominantly dilute nitric acid and other inorganic contaminants.

3.2.3 Decontamination Flushes Chemicals

See Attachment 3 for a list of the decontamination solutions used following the PUREX operations.

The list of decontamination solutions on Attachment 3 includes 1-14% Turco 4182A and 10-20% Oakite #31. Contact was made with Hanford Environmental Health Foundation (HEHF) to ascertain the chemical constituents of these two solutions. Turco 4182A contains Ammonium Bicarbonate (50% by weight) and Sodium Hexametaphosphate (45% by weight). Oakite is no longer used; however, HEHF has contacted the past manufacturer to obtain the chemical constituents in Oakite. Oakite #31 contains phosphoric acid (60-70%) and Nonylphenoxy Polyethoxy Ethanol (less than 5%). The information on Turco 4182A provided from HEHF is based on the current formula. A formula change over the years is possible but no record to ascertain this is available.

Although the types of chemicals and chemical compositions that were used were documented, the quantities used and the current compositions are unknown; i.e., limestone present in the tank would have neutralized chemicals such as nitric acid.

A formal waste designation has not been performed on the waste in this tank because the quantity, concentrations, and current chemical compositions are not known.

It is known that Sodium Dichromate was used in the decontamination flushes. The presence of chromium would cause the tank to be designated as a potentially DANGEROUS WASTE. Other constituents, especially fluoride, would also contribute to the DANGEROUS WASTE designation.

4.0 CONCLUSIONS

Based on historical documentation, the following provides an assessment of the radiological and chemical characterization of Tank 241-CX-71.

Tank 241-CX-1 was used to neutralize waste from the 201-C building and the Hot Shop sink before routing to Crib 216-C-1. Tank 241-CX-71 and Crib 216-C-1 were used during the REDOX operations, the PUREX operations, and the decontamination flushes following completion of the PUREX operations.

4.0 CONCLUSIONS (Cont'd)

No reliable historical radiological inventory estimates are available for Tank 241-CX-71; however, estimated radionuclide inventories are given for Crib 216-C-1 (see Attachment 5). Although no correlation of the quantities of radionuclides estimated for Crib 216-C-1 can be made for Tank 241-CX-71, it would be expected that the tank and the crib would share the same species of radionuclides. No recent radiological characterization investigations have been performed on this tank.

Although the types of chemicals and chemical compositions used during the REDOX operations, the PUREX operations, and the decontamination flushes following completion of the PUREX operations are documented, the quantities used and the current compositions are unknown. For example, limestone present in the tank would have neutralized such chemicals as nitric acid.

A formal waste designation has not been performed on the waste in this tank because the quantity and concentrations of constituents is not known. Although the composition of the decontamination flushes used is known, the quantity used for each flush is not known. The presence of chromium in the decontamination flushes would cause the tank contents to be designated as potentially DANGEROUS WASTE. Other constituents, especially fluoride, would also influence the DANGEROUS WASTE designation.

The radiological and chemical constituents estimated for this tank can only be confirmed by direct analysis of representative specimens retrieved from the tank. Because of the grout, limestone, and sludge layers in this tank, sampling of the different strata of the contents of this tank is recommended. This approach requires adherence to mandated sampling and documentation protocols.

5.0 ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the support provided by Dr. Vishnu Subrahmanyam of Analytical Systems Laboratories. His advice and technical review of the report are greatly appreciated.

6.0 REFERENCES

The following documentation was reviewed to assist in the preparation of this report:

Westinghouse Document, SD-DD-TI-034, "Tank 241-CX-70 Waste Removal Assessment," October 31, 1988.

General Electric Document, HW-52860, "Standby Status Report Hot Semiworks Facility," September 1, 1957.

6.0 REFERENCES (Cont'd)

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Rockwell Document, SD-DD-FL-001, "Rockwell Retired Contaminated Facility Listing and Description," July 19, 1982.

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Battelle Document, "Level 1 Remedial Investigation Work Plan - 200 Area Strontium Semiworks Liquid Waste Disposal Site," September 1987.

Rockwell Document, D0105ER0001, "Preliminary Study for Decontamination and Decommissioning of Strontium Semiworks," October 1, 1979.

Rockwell Document, SD-DD-ES-003, "Strontium Semiworks Decommissioning Engineering Study," July 1983.

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Internal Letter, G. J. Pilicy to D. R. Speer, "Environmental Evaluation for Decommissioning Hot Semiworks," dated August 31, 1983.

Internal Letter, D. W. Fukumoto to W. M. Hayward, "Concrete Specifications for A, C, D, and E Cells, Galleries, Tanks, and Labyrinth," dated July 26, 1985.

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Rockwell Document, SD-DD-AP-001, "201-C Radiological Characterization Plan," February 15, 1983.

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6.0 REFERENCES (Cont'd)

Rockwell Document, SD-DD-PP-001, "Strontium Semiworks Decommissioning Project Plan," August 1983.

Rockwell Document, SD-WM-SAR-003, "The Safety Analysis Report for the Decontamination and Decommissioning of Strontium Semiworks Complex," March 1984.

DOE Document, DOE/EA-0259, "Environmental Assessment Relating to the Decommissioning of Strontium Semiworks Facility," May 1985.

Letter, G. Burton to O. J. Elgert, "Waste Tank Survey," dated June 2, 1976.

7.0 ATTACHMENTS

7.1 ATTACHMENT 1 - STRONTIUM SEMIWORKS TIME SEQUENCE

7.2 ATTACHMENT 2 - TANK 240-CX-71 CONFIGURATION

7.3 ATTACHMENT 3 - DECONTAMINATION SOLUTIONS USED FOLLOWING PUREX OPERATIONS

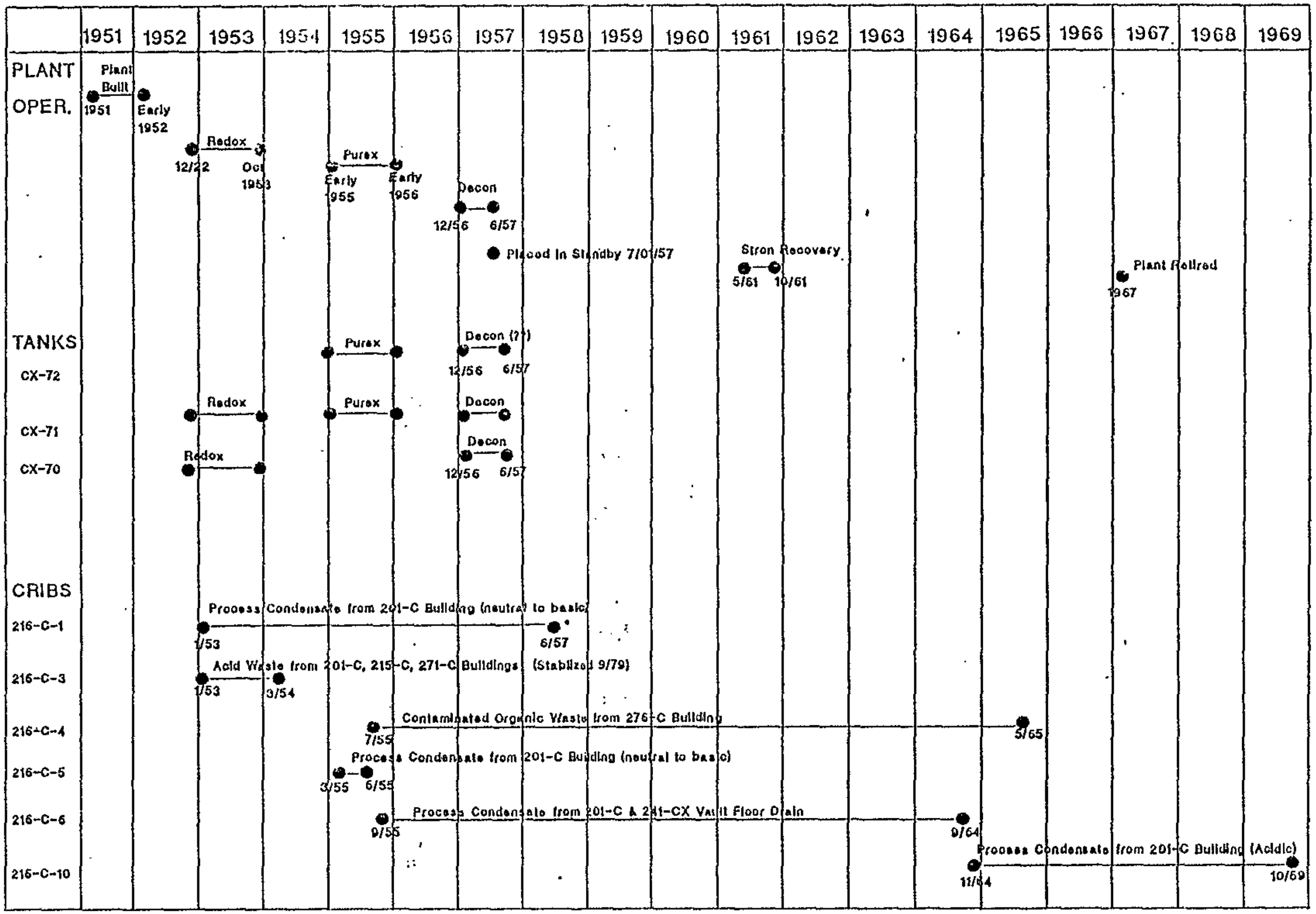
7.4 ATTACHMENT 4 - DESCRIPTION OF SEMIWORKS CRIBS

7.5 ATTACHMENT 5 - ESTIMATED CONTAMINANT INVENTORY FOR SEMIWORKS CRIBS

9 1 1 1 1 1 1 0 7 3 3

ATTACHMENT 1

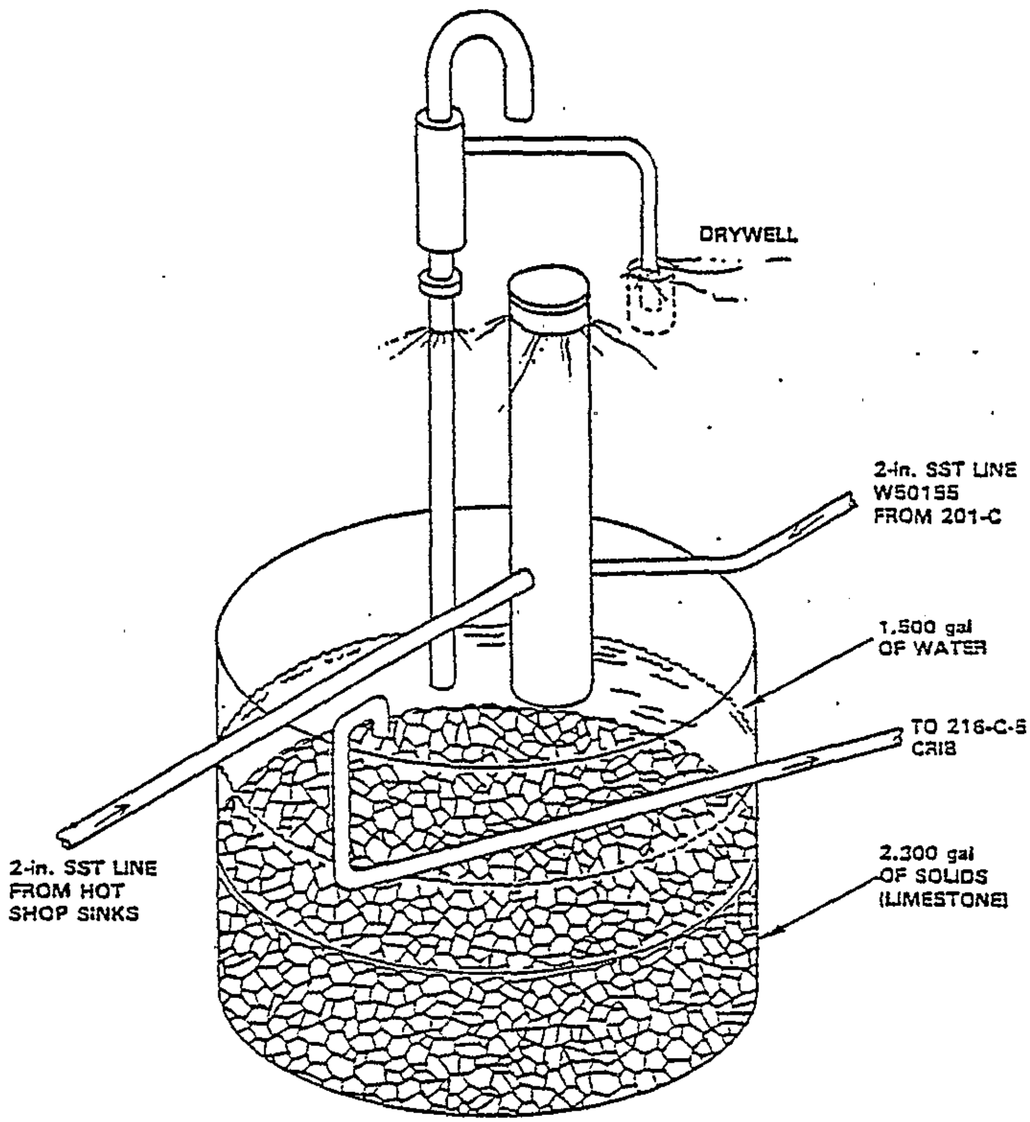
STRONTIUM SEMIWORKS TIME SEQUENCE



AUTHOR: J. E. Cummings 6/22/89

ATTACHMENT 2

TANK 241-CX-71 CONFIGURATION



TANK 241-CX-71
(9 ft IN DIA BY 9 ft TALL)

ATTACHMENT 3

DECONTAMINATING SOLUTIONS USED FOLLOWING PUREX OPERATIONS

Contamination	Code	Composition (Wt. %)	Application Temperature
Ru	PC	1-1/2% $KMnO_4$ (Permanganate) 1/2% NaOH (Caustic)	60° C
Ru	CP	5% NaOH (Caustic) 2% H_2O_2 (Peroxide)	40° C
Zr-Nb	CT	6% NaOH (Caustic) 1-1/2% Tartaric Acid (Tartrate)	80-100° C
Zr-Nb	CTP	6% NaOH - 1-1/2% Tartaric acid - 2% H_2O_2 (Caustic-Tartrate-Peroxide)	25-30° C
Zr-Nb	HF	5% HNO_3 - 1% NaF (Nitric-Fluroide)	25-30° C
MnO_2 (from PC)	N-F-FAS	5% HNO_3 - 1% NaF - 2% Fe $(NH_4)_2$ $(SO_4)_2$ (Nitric-Fluoride-Ferrous Ammonium Sulfate)	25-30° C
MnO_2	N-FAS	5% HNO_3 - 2% Fe $(NH_4)_2$ $(SO_4)_2$ (Nitric-Ferrous Ammonium Sulfate)	25-30° C
All	3-20	6.9% NaF - 27.7% HNO_3 (3% HF - 20% HNO_3)	25-30° C
Zr-Nb	OX	5% $H_2C_2O_4$ (Oxalic Acid)	80° C
Grease plus FP	TSP	2% Na_3PO_4 (Trisodiumphosphate)	80-100° C
Ce, Cs	ND	6 Molar HNO_3 - 10% Sodium Dichromate	50° C
Pu	SD	Mixture of sulfuric accid and sodium dichromate	50° C
All	Oakite	10 - 20% Oakite #31	
on Masks	Turco	1 - 14% Turco 4182A	

NOTE: Exposure to solutions may vary from 15 minutes to 2 hours.

ATTACHMENT 4

DESCRIPTION OF SEMIWORKS CRIBS

Site	Type of Structure	Dates of Service	General Description of Waste Stream	Volume of Waste
216-C-1	Concrete Crib	1/53 - 6/57	Process Condensate from 201-C Bldg. (Neutral to Basic)	2.34×10^7 liter
216-C-3	Gravel Crib	1/53 - 3/54	Acidic Waste from 201, 215, 271-C Bldgs.	5.0×10^6 liter
216-C-4	Gravel Crib	7/55 - 5/65	Contaminated Organic Waste from 276-C Bldg.	1.7×10^5 liter
216-C-5	Gravel Crib	3/55 - 6/55	Process Condensate from 201-C Bldg. (Neutral to Basic)	3.79×10^4 liter
216-C-6	Gravel Crib	9/55 - 9/64	Process Condensate from 201-C Bldg. and 241-CX vault floor drain.	5.3×10^5 liter
216-C-10	Gravel Crib	11/64 - 10/69	Process Condensate from 201-C Bldg. (Acidic)	8.97×10^5 liter
216-C-2	Dry Well	1/53 - present	Stack and Water Seal Drainage from 291-C Stack and Filter System	Unknown-assumed low

ATTACHMENT 5

ESTIMATED CONTAMINANT INVENTORY FOR SEMIWORKS CRIBS

Estimated Quantity of Chemicals Disposed (kg)

Site	NO_3	TBP	Kerosene	HNO_3	Na	MIBK
216-C-1	0	0	0	15000	0	NA*
216-C-3	0	0	0	NA	0	NA
216-C-4	0	14000	24000	0	0	NA
216-C-5	8000	0	0	0	3000	NA
216-C-6	330	0	0	0	0	NA
216-C-10	0	0	0	600	0	NA
216-C-2	NA	NA	NA	NA	NA	NA

Estimated Radionuclide Inventory (Curies)
(Decayed through 4/1/86)

Site	^{3}H	^{60}Co	^{90}Sr	^{137}Cs	^{239}Pu	^{240}Pu	^{238}U
216-C-1	70.000	.0020	93.800	.0496	.4570	.1230	.0988
216-C-3	0	.0014	8.830	.0463	.0571	.0154	.0153
216-C-4	0	.0018	13.000	.0472	.0571	.0154	.0011
216-C-5	0	.0018	4.610	.0484	.0571	.0154	.0182
216-C-6	0	.0025	31.600	.0507	.0571	.0154	.00001
216-C-10	0	.0113	37.800	.0932	.0086	.0023	.00001
216-C-2	NA	NA	NA	NA	NA	NA	NA

* NA — No Information Available.

Source: DOE, 1986a